August 19, 2019

Arizona Corporation Commission
1200 W. Washington Street
Phoenix, AZ 85007

Re: Tesla Response to Commissioner Kennedy's August 2nd Letter Regarding Lithium-Ion Battery Safety/Docket No. E-01345A-19-0076

Tesla, Inc. provides these comments in response to Commissioner Kennedy's August 2, 2019 letter, "In the Matter of the Commission Inquiry of Arizona Public Service Battery Incident at the McMicken Energy Storage Facility Pursuant to Arizona Administrative Code R14-2-101," referred to hereafter as "the August 2nd letter."

Tesla appreciates and understands the Commissioner's interest in ensuring that battery energy storage technologies are safe, but there are a number of apparent misunderstandings of lithium-ion batteries in the August 2nd letter that should be corrected. Although Tesla's storage systems were not involved in the Arizona fires that the Commission is investigating, Tesla is a leader in lithium-ion battery energy storage technology, having safely manufactured and deployed over two gigawatt-hours of stationary energy storage around the world. As such, Tesla believes the information in this letter should be helpful as the Commissioners continue to educate themselves on battery energy storage technology.

Further, Tesla highly recommends the Commission look to the long-standing, independent experts on matters of fire safety for further guidance. The International Code Council ("ICC") and the National Fire Protection Association ("NFPA") have been the source of truth for appropriate fire codes and standards for decades. They have both recently updated their codes and standards for energy storage to set more stringent rules that would now preclude the types of storage systems that have had fire incidents in Arizona over the last several years.

I. Responses to Assertions in the August 2nd Letter

Tesla recommends that the Commission avoid generalizations about lithium-ion storage like "lithium ion batteries are not prudent and create unacceptable risks."[1] "Lithium-ion batteries" actually encompasses a broad set of storage technologies – there are many different sub-chemistries of lithium-ion batteries, each with their own unique characteristics. Common lithium-ion sub-chemistries for stationary storage include nickel manganese cobalt oxide (NMC) and lithium iron phosphate (LFP) but there are many other sub-chemistries such as lithium manganese oxide (LMO) and nickel cobalt aluminum oxide (NCA). Different types of lithium-ion battery systems have different properties and associated risks.

For example, the August 2nd letter notes that "the cabinets involved [in the 2012 Elden fire] are full of lithium batteries that are extremely volatile if they come into contact with water."[2] While it may be true that the type of lithium batteries used at the Elden Substation facility are volatile when they come in contact with water, which is true for many lithium *metal* batteries, this is not true for the lithium-*ion* batteries that are being deployed today. In fact, water is the preferred agent for suppressing lithium-ion battery fires, and the latest research[3] as well as regulations from the National Fire Protection Association and the International Code Council[4] require water suppression for lithium-ion batteries. The lithium deployed in today's energy storage systems is absorbed into

[1] August 2nd Letter, at p. 1.
[2] August 2nd Letter at p. 2.
[3] National Fire Protection Association, "Sprinkler Protection Guidance for Lithium-Ion Based Energy Storage Systems, June 2019, available at https://www.nfpa.org/News-and-Research/Data-research-and-tools/Suppression/Sprinkler-Protection-Guidance-for-Lithium-Ion-Based-Energy-Storage-Systems.
[4] NFPA 855 Energy Storage Systems and 2018/2021 International Fire Code.

the electrolyte and trapped in a crystalline structure in the same way that chlorine is trapped in table salt, and thus is not hazardous.

Further, the August 2nd letter focuses extensively on the release of hydrogen fluoride, but Tesla's lithium-ion battery cells, and likely most other battery cells deployed today, do not release any hydrogen fluoride when burned. The trace levels of hydrogen fluoride measured during fire testing of Tesla battery storage products come from the combustion of standard electrical components like conduit, plastics, and power electronics, not from the combustion of the lithium-ion cells themselves. These trace levels of hydrogen fluoride are similar to those found in typical Class A household fires, and do not pose any elevated threats to first responders or others. Third-party large-scale testing of Tesla's storage systems have shown that the hazards to the environment and required fire response equipment are no different than that for a typical Class A fire.[5]

The August 2nd letter goes on to state that "there are other utility scale battery technologies that are available that are far more sustainable and do not have these risks," and it identifies zinc air batteries, nickel-iron batteries, and magnesium batteries.[6] While Tesla strongly encourages open competition amongst all storage technologies, the Commission should understand that lithium-ion battery storage technologies are the only widely used grid-scale storage technologies available today other than pumped hydro storage. Bloomberg New Energy Finance data shows that of the more than 2,000 megawatts of energy storage deployed in 2018, only 3.5% of the storage deployed was identified as a technology other than lithium-ion batteries – some lead acid and sodium sulfur storage.[7] Bloomberg reported that 85% of the storage deployed in 2018 was some type of lithium-ion battery storage, and the remaining 11.5% of deployments did not have a disclosed technology.[8]

The August 2nd letter indicates that lithium-ion battery facilities can "easily" have a fire and/or explosion,[9] which is simply not true. Gigawatt-hours of stationary battery storage have been deployed across thousands of sites in the United States with very few thermal events, the most notable of which are likely these two incidents in Arizona that happened using old storage technology. Tesla storage products and those of other manufacturers on the market today that conform to current codes and standards, including UL 1973[10] and UL 9540,[11] are designed to prevent propagation of fire between cells and packs, thus preventing major fires or explosions.

Finally, while utilities should do everything possible to mitigate fire risk, it is important to acknowledge that fire risk is part of the normal course of business when dealing with electrical equipment. Utility equipment regularly causes fires due to downed power lines, contact with vegetation, conductor slap, repetitive faults, apparatus failures, and other common issues. While national statistics on the number of fires caused by electrical equipment seem to be lacking, Texas A&M's Wildfire Mitigation Project provides a good anecdote – Texas A&M reports that more than 4,000 fires were caused by electrical equipment in Texas in the last 3.5 years alone.[12] Fire hazards are real concerns when dealing with any electrical equipment, including battery storage, but when appropriate precautions are taken, the risks from lithium-ion battery storage are not dissimilar from those posed by standard utility equipment.

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[5] Large-Scale Fire Test of Tesla Powerpacks, DNV-GL, April 17, 2019.
[6] August 2nd Letter at, p. 3-4.
[7] Bloomberg New Energy Finance, "1H 2019 Energy Market Outlook," February 20, 2019.
[8] Ibid.
[9] August 2nd Letter, at p. 2.
[10] UL 1973, "Standard for Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail Applications, February 7, 2018, available at https://standardscatalog.ul.com/standards/en/standard_1973_2.
[11] UL 9540, "Standard for Energy Storage Systems and Equipment, November 21, 2016, available at https://standardscatalog.ul.com/standards/en/standard_9540_1.
[12] Texas A&M, "Texas Wildfire Mitigation Project: How Do Power Lines Cause Wildfires," available at https://wildfiremitigation.tees.tamus.edu/faqs/how-power-lines-cause-wildfires.

II. Recent IFC and NFPA Codes and Standards for Energy Storage Provide Stringent Requirements that Ensure Appropriate Fire Safety Precautions

Tesla has worked closely with firefighters, enforcers, other industry members, and codes bodies over the last few years to develop updated, stringent fire codes and standards for energy storage systems. Both the International Code Council (ICC) and the National Fire Protection Association (NFPA), the two most respected bodies in charge of setting fire safety requirements, have made changes to their storage-related codes and standards as recently as this year.

The ICC's 2018 and 2021 International Fire Codes (IFC), which are in the process of being adopted by states, regional, and local jurisdictions, incorporate new requirements for the storage, maintenance, and operation of energy storage systems.[13] Until 2018, the fire and building codes for energy storage had not been materially updated since 2006 and were primarily written for lead acid batteries with minimal requirements for systems employing lithium-ion batteries. However, the 2018 IFC introduced tougher requirements for storage with exceptions only allowed through large-scale fire testing, and the 2021 IFC, which is currently being prepared for printing, has even more requirements for storage. The 2021 IFC language specific to energy storage systems is currently being adopted by some state and local jurisdictions prior to printing of the entire IFC by the ICC.

Also, the NFPA 855 Energy Storage Standard,[14] which is a new NFPA standard for the installation of energy storage systems, is in its final stages of development and is expected to be approved by the end of 2019. NFPA 855 is designed to mitigate hazards based upon various battery technologies, and it imposes a high bar for safety based on historical precedent and documented technology safety claims.

To avoid future events like those that occurred at the McMicken and Elden energy storage facilities, the Commission should ensure that all new energy storage systems meet the requirements of the new NFPA 855 standard and the 2021 IFC code. These new codes and standards stipulate the use of validated detection, suppression, and other safety features, such as deflagration venting and exhaust particularly for indoor and containerized systems, which would have prevented the McKicken and Elden storage systems from being deployed as designed. Instead, large-scale fire testing would have been required to understand the hazards posed, and design changes based upon the results of the large-scale fire testing would have been necessary to mitigate the risks posed by the McMicken and Elden energy storage systems.

III. Conclusion

It is important to recognize how far energy storage technology and the related safety codes and standards have come over the last several years as the energy storage industry has grown exponentially. Tesla has specifically chosen lithium-ion batteries for their performance, longevity, and safety properties. In fact, Tesla's lithium-ion storage systems fit well into Commissioner's Kennedy's request for storage systems that are "sustainable, less risky, and do not utilize chemistries that have a potential to release hydrogen fluoride."[15]

Tesla looks forward to continuing to support the Commission as it seeks to learn more about battery storage technology. Please reach out if we may be of help.

Sincerely,

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[13] The International Code Council's Series of Codes including the IFC are available at https://www.iccsafe.org/.
[14] NFPA 855, "Standard for the Installation of Stationary Energy Storage Systems," available at https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=855.
[15] August 2nd Letter, at p. 4.